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LXV.—*The Classification of the Teleostean Fishes of the Order Ostariophysi.*—2. *Siluroidea**. By C. TATE REGAN, M.A.

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THE Siluroids may be thus defined:—Ostariophysi with the body naked or covered with bony plates, the mouth non-protractile and the branchiostegal rays often numerous; parietals, symplectic, and suboperculum absent; second, third, and fourth vertebræ ankylosed to form a complex to which the fifth is rigidly attached; parapophyses ankylosed with centra; epipleurals and epineurals absent.

As in all Ostariophysi, there is no basisphenoid, but an orbitosphenoid is always present; the latter joins the frontals above, the parasphenoid below, the lateral ethmoids in front, and the alisphenoids behind. There is no opisthotic, but the other otic bones are present; the epiotics are rarely prominent, but in the Doradidæ they are important elements of the cranial roof. The præmaxillaries are typically fixed, but in the Callichthyidæ and Loricariidæ they are movably articulated with the mesethmoid; sometimes the toothed præmaxillaries extend right back to the angle of the mouth (*Wallago*, *Ageniosus*, *Asterophysus*), and the posterior extension may segment off as a distinct bone (*Eutropiichthys*),

* The Cyprinoidea have been dealt with in a separate paper, *suprà*, p. 13.

simulating a toothed maxillary. In *Diplomystes* the maxillary is expanded distally and toothed, but in all other Siluroids it is toothless, serving only as the base of a barbel; in *Eutropiichthys* the small toothless maxillary bears a barbel and articulates with the anterior end of the palatine just as in the closely allied *Schilbichthys*. The palatine articulates with the lateral ethmoid and bears the maxillary; the pterygoid, when present, is small, connecting the palatine with the mesopterygoid; the metapterygoid is always well developed, suturally united with the quadrate and usually with the hyomandibular. The operculum and interoperculum are constantly present; the lower pharyngeals are toothed (except in some Loricariidæ), separate (except in *Hypophthalmus*), opposed to a single pair of dentigerous patches supported by the third and fourth pharyngobranchials, the first and second being absent.

The pectoral arch of the Siluroids is highly characteristic; the post-temporal, when present, is a small plate rigidly attached to the skull, overlying the suture between epiotic and pterotic and reaching the supraoccipital; distally it overlaps the proximal extremity of the supra-cleithrum, which is typically forked, the upper limb usually rigidly attached to pterotic and epiotic, the lower to the basioccipital; sometimes the lower limb is absent (Clariidæ, Callichthyidæ, Loricariidæ); the distal part, "stem," of the supra-cleithrum, beyond the fork, is deeply cleft to form a socket for the head of the cleithrum. The mesocoracoid is usually present, but is wanting in three families, Ariidæ, Doradidæ, and Bunocephalidæ; the hypocoracoids usually form an interlocking symphysis behind that of the cleithra, but in certain groups (Siluridæ, Trichomycteridæ) they taper forwards below and do not form a symphysis. The pectoral radials are three in number, the first short, the outer ones more or less elongate.

The centrum of the first vertebra is a disc, rigidly united and often ankylosed to the basioccipital and to the complex centrum, which is formed by the fusion of the second, third, and fourth; the first parapophysis is that of the fourth vertebra, corresponding to the *os suspensorium* of the Cyprinoids; the fifth vertebra is rigidly attached to the complex and its parapophysis also supports the air-bladder. The sixth and following vertebræ usually bear ribs attached to normal parapophyses, but the anterior (*Pseudecheneis*, *Callichthys*, Doumeinæ) or all (*Corydoras*, Loricariidæ, Bunocephalidæ) the ribs may be sessile.

The "nuchal shield," which is so characteristic of many

Siluroids, is formed by a process of the supraoccipital and by three plates which are expansions of the distal ends of the "interneurals" (basalia + radalia) of the first three rays of the dorsal fin. These bones are directed obliquely upwards and backwards, in such a way that the fin-ray articulates with the distal end of its own radial and also rests upon the upper part of the one behind it; when the second dorsal ray forms a spine it is the third interneural which becomes enlarged to support it, whilst the second bears the short anterior spine and the first is set free, sometimes expanding to form the first nuchal plate.

The air-bladder, when well developed, differs from that of the Cyprinoids in that it is divided into anterior and posterior divisions not by a constriction but by an internal partition; the posterior division is rendered non-distensible by the development of longitudinal and transverse septa, whilst the anterior gives rise to the pneumatic duct, is connected with the triplus, and usually extends laterally to beneath the skin above the pectoral fin. The parapophysis of the fourth vertebra is usually divided into an anterior branch, decurved and firmly attached distally to the stem of the supra-cleithrum, and a posterior horizontal branch; these give attachment to the anterior and dorsal walls of the anterior chamber of the air-bladder.

Modifications of the simple condition just described may be of two kinds—(1) The anterior ramus of the parapophysis of the fourth vertebra loses its attachment to the supra-cleithrum, its proximal end forms a thin laminar stem and its distal end an expanded plate, inserted in the wall of the air-bladder and furnished with a muscle attached anteriorly to the skull, the whole forming an "elastic spring mechanism." A posterior diverticulum of the air-bladder is often found in Siluroids with this arrangement, which occurs in the Doradidæ, Pangasiidæ, Synodontidæ, and Malopteruridæ.

(2) The air-bladder is reduced, the posterior part disappearing and the anterior part becoming divided into two lateral portions which may be completely disconnected; concurrently the fourth and fifth transverse processes tend to surround and encapsule the air-bladder, in the most specialized types forming complete bony cylinders, open only at their outer ends.

Günther* regarded the Siluroids as a single family, and his classification, based on external characters only,

* Cat. Fish. v. (1864).

was in most respects satisfactory. Several authors have given family names to some of Günther's groups*, and of these the Eigenmanns† have utilized differences in the structure of the vertebral column and the air-bladder in order to characterize the South-American families. Boulenger‡ separated off as two families the Siluroids with all the ribs sessile, retaining the remainder in one family, Siluridæ, divided into eight subfamilies characterized by the length of the dorsal and anal fins, the freedom or union with the isthmus of the gill-membranes, &c., the majority of these groups being unnatural.

Bridge and Haddon's § great memoir on the Siluroid air-bladder is of considerable service in working out the classification. Comparatively little has been written on the osteology of the Siluroids, although Koschkaroff|| has recently given a useful account, with figures, of the skeletons of several genera. The scheme here put forward is based on the examination of a large series of skeletons, and a far greater number of families is recognized and defined than in any previous system. The majority of these are much better characterized than most of the families of Percoids; the differences between the Lutianidæ and Scænidæ, for example, are trifling compared with those between the Synodontidæ and Doradidæ, which have usually been associated in the same subfamily.

In the following account I place first the Diplomystidæ, more generalized than any of the others in the normally formed toothed maxillary and in the simple attachment of the fifth vertebra to the complex. Next the Ariidæ and Doradidæ are considered, generalized in form and in fin-structure, but aberrant in the loss of the mesocoracoid, and they are followed by the Plotosidæ and Siluridæ, which have a very long anal fin, but are primitive in some other characters, such as the many-rayed pelvic fins. Then come the Bagridæ, widely distributed in Asia and Africa, and they are followed by the North-American Amiuridæ and by a number of Old-World families which may be regarded as

* Gill (Smithson. Misc. Coll. xi. 1872) named, but defined only by references to Günther's Catalogue, the families Hypophthalmidæ, Trichomycteridæ, Siluridæ, Chacidæ, Plotosidæ, Clariidæ, Callichthyidæ, Argiidæ, Loricariidæ, Sisoridæ, and Aspredinidæ.

† Occ. Papers Calif. Acad. i. (1890).

‡ Cambridge Nat. Hist. Fish. p. 586 (1904).

§ Phil. Trans. clxxxiv. (B) 1893, p. 65.

|| Bull. Soc. Nat. Moscow, 1905, p. 209. The genera described are *Loricaria*, *Synodontis*, *Macrones* or a related genus wrongly named *Akysis*, *Clarias*, *Silurus*, *Arius*, *Eutropius*, *Malopterus*.

specialized Bagridæ, Amblycepidæ, Sisoridæ, Amphiliidæ, Chacidæ, Schilbeidæ, Clariidæ, Pangasiidæ, Synodontidæ, and Malopteruridæ. The neotropical Siluroids (except the Doradidæ) come last, and these begin with the Pimelodidæ, which represent the Bagridæ in South America, and are followed by the Helogenidæ, Hypophthalmidæ, Trichomycteridæ, and Bunocephalidæ, ending with the highly specialized Callichthyidæ and Loricariidæ, which are the most aberrant fishes of the order.

Family 1. Diplomystidæ. (Fig. 2, C.)

Body naked, moderately elongate. Gill-membranes united, but free from isthmus. Dorsal fin anterior, with a spine; adipose fin present; anal short; pelvics 6-rayed; pectoral with a spine. Nostrils close together; a pair of maxillary but no other barbels; præmaxillaries fixed; maxillary well developed, toothed, expanded distally, and proximally articulated with both heads of the palatine; bands of villiform teeth in jaws, obtuse teeth on the vomer. Palatine forked anteriorly; no pterygoid; mesopterygoid very small, connecting metapterygoid with vomer; metapterygoid attached to palatine anteriorly and to orbitosphenoid internally; head of hyomandibular broad, articulating with pterotic, sphenotic, and alisphenoid. Post-temporal present; supra-cleithrum forked; mesocoracoid present; hypocoracoids narrowed forward below, not meeting. Vertebræ 42 (17 + 25); ribs on parapophyses; fifth vertebra rigidly attached to complex, but not forming interlocking sutures; parapophysis of fifth vertebra normal, of fourth a transverse lamina with a stout somewhat decurved anterior process firmly attached to the stem of supra-cleithrum; first centrum well developed, separating complex from basioccipital.

Diplomystes papillosus from Chili and Argentina.

In all the remaining Siluroids the maxillary is slender, toothless, and the fifth and complex vertebræ unite by interlocking sutures or are ankylosed or united by investing bone.

Family 2. Ariidæ.

Naked, moderately elongate; gill-membranes united, forming a fold across isthmus. Dorsal fin anterior, with a spine; adipose fin present; anal short or of moderate length; pelvics 6-rayed; pectoral with a spine. Mouth terminal; teeth in jaws and often on palate; nostrils usually close together, without barbel; maxillary and one or two pairs of mandibular barbels. Epiotics with posterior

laminae which (except in *Galeichthys*) extend to and unite with the posterior rami of the parapophyses of the fourth vertebra; a pair of large thin-walled bullae formed by pro-otic, pterotic, and exoccipital; a stout subconical inferior process at the junction of basioccipital and complex vertebra. Palatine rod-like; pterygoid, when present (*Ælurichthys*) very small, adherent to lower surface of posterior part of palatine; mesopterygoid small, lying between the lateral ethmoid and the large metapterygoid. Post-temporal present; supra-cleithrum with stout lower limb united by suture with basioccipital; no mesocoracoid; hypocoracoids interlocking below. Vertebrae 48 to 58 (22-29 + 27-33); ribs on well-developed parapophyses; one, two, or three rib-bearing vertebrae (sixth to eighth) rigidly united to fifth and complex by a backward extension of investing bone over their centra; parapophysis of fifth vertebra enlarged, suturally united to that of the fourth, which is an expanded lamina with a decurved anterior process rigidly attached to the limb of supra-cleithrum. Air-bladder large, free, normal.

Fishes of the shores and estuaries of tropical and sub-tropical regions, a few species perhaps permanently fluviatile.

Principal genera: *Arius*, *Galeichthys*, *Ancharius*, *Genidens*, *Hemipimelodus*, *Ketengus*, *Ælurichthys*, *Batrachocephalus*, *Osteogeneiosus*.

Family 3. *Doradidæ*. (Fig. 3, A.)

Body moderately elongate. Gill-membranes broadly united to the isthmus. Dorsal fin anterior, with a spine; adipose fin usually present; anal short or rather long; pelvics 6- to 16-rayed. Mouth terminal; jaws usually toothed; maxillary and one or two pairs of mandibular barbels; nostrils remote, without barbels. Palatine rod-like; pterygoid absent; mesopterygoid present, connecting metapterygoid with lateral ethmoid. A nuchal shield; epiotics prominent on the upper surface of the skull, united by suture with both nuchal plates, and giving rise posteriorly to more or less developed backwardly directed processes*. No post-temporal; supra-cleithrum suturally united with skull, the upper limb to the pterotic and epiotic, the lower to the basioccipital and exoccipital; no mesocoracoid; hypocoracoids interlocking below. Vertebrae 36 to 58 (13-17 +

* These are short pointed projections in *Doras* and *Oxydoras*, but in *Hemidoras* they extend backwards to the inferior processes of the posterior nuchal plates. In the other genera the epiotic processes are forked, the inner limbs running to the parapophyses of the sixth vertebra.

23-41); ribs on transverse processes; eighth or ninth the first free vertebra; parapophyses of fifth vestigial or absent; parapophyses of fourth undivided, proximally thin, laminar, distally forming expanded subvertical oval plates, free from the supra-cleithra, applied to the lateral walls of the anterior part of the air-bladder.

South American fresh-water fishes.

The principal genera may be arranged thus:—

- I. A series of bony plates on each side; mouth rather small; pelvic fins 7-rayed; air-bladder large, free, normal or with a posterior cæcum *Doras, Oxydoras, Hemidoras.*
- II. Body naked; pelvic fins 6- to 16-rayed; air-bladder large, free, normal or with a posterior cæcum.
 - A. Mouth rather wide, not extending beyond eye; præmaxillaries fixed, transverse *Centromochlus, Trachelyopterus, Trachelyopterichthys, Pseudauchenipterus, Auchenipterus (Euanemus), Trachycorystes, Epapterus, Tetranematichthys.*
 - B. Mouth very wide, extending far beyond eye; præmaxillaries extending to angle of mouth *Asterophysus.*
- III. Body naked; pelvic fins 7-rayed; air-bladder very small, partly enclosed in two small spherical or pyriform capsules separated by a septum and attached to the aortic ridges, with small posterior and larger supero-lateral apertures; the reduced plates of the "spring apparatus" attached to the free wall of the air-bladder at the larger openings; mouth wide, the movable præmaxillaries extending to its angle *Ageniosus.*

Family 4. Plotosidæ.

Body naked, elongate; gill-membranes free or narrowly attached to the isthmus. Dorsal fin well developed, with a spine, placed anteriorly; no adipose fin; anal very long, confluent with the caudal, which may extend forward along the back, simulating a second dorsal fin; pelvics 10- to 16-rayed. Nostrils remote, the posterior with a barbel; on each side one or two maxillary and two mandibular barbels. Teeth in jaws conical or obtuse; a patch of blunt molars on the vomer. Palatine rod-like; mesopterygoid rather small, attached to head of vomer and to the large metapterygoid, which is connected with the palatine external and the orbitosphenoid internal to its union with the mesopterygoid; head of hyomandibular very broad, articulating with pterotic, sphenotic, and alisphenoid. Skull depressed; sphenotics projecting laterally but not produced forwards, the frontals with free margins. Post-temporal present; lower fork of supra-cleithrum well developed, attached to basioccipital;

mesocoracoid present; hypocoracoids interlocking below. Vertebrae 46 to 81 (16-19+30-65); ribs attached to long parapophyses; anterior ramus of parapophysis of fourth vertebra decurved, rigidly attached to the stem of supra-cleithrum, more or less expanded, together with expanded processes of the aortic ridges supporting the anterior wall of the large free air-bladder.

Marine fishes of the Indo-Pacific, entering rivers, and with some permanently fluviatile species.

Genera: *Eumeda*, *Neosilurus*, *Copidoglanis*, *Plotosus*, *Cnidoglanis*, *Euristhmus*.

Family 5. Siluridæ.

Body naked, elongate; gill-membranes free from isthmus. Dorsal fin, when present, small, without spine; no adipose fin; anal very long, many-rayed, ending close to the caudal or continuous with it; pelvics 6- to 14-rayed. Anterior and posterior nostrils wide apart; no nasal barbel; maxillary and often one or two pairs of mandibular barbels. Teeth in jaws and often on palate. Palatine short and broad, articulating with an antero-lateral facet of the lateral ethmoid; pterygoid absent; mesopterygoid small, connecting the large metapterygoid with the vomer; hyomandibular with a broad head, articulating with pterotic and sphenotic. Lateral ethmoid with a projection for the attachment of the præ-orbital and with a slender posterior extension which meets a similar forward extension of the sphenotic, so that the frontal has no free edge. Post-temporal absent; upper limb of supra-cleithrum wedged between pterotic and epiotic, lower running to basioccipital; mesocoracoid present; hypocoracoids tapering forward below, not forming a symphysis. Vertebrae 52 to 74 (10-16+41-58); ribs attached to long parapophyses; sixth vertebra free; anterior and posterior rami of parapophysis of fourth vertebrae connected at the base only, the anterior stout, firmly attached to the limb of supra-cleithrum; air-bladder free, usually large.

Fresh-water fishes of Europe and Asia.

The genera may be arranged thus:—

- I. Eye above the level of the mouth; hypocoracoids slender.
Silurus, *Parasilurus*, *Silurichthys*, *Wallago*, *Belodontichthys*.
- II. Eye behind the angle of mouth; hypocoracoids expanded.
Callichrous, *Cryptopterus*, *Hemisilurus*.

This family has usually been united with the Schilbeidæ, but the two have very little in common beyond the elonga-

tion of the anal fin. The many-rayed pelvic fins, the contiguous or confluent anal and caudal, combined with the absence of a dorsal spine, of an adipose fin, and of nasal barbels, characterize the Siluridæ externally, whilst the osteology is quite different from that of the Schilbeidæ, with their rod-like palatine, frontals with free edges, and lateral ethmoids not projecting outwards.

Family 6. Bagridæ.

Body naked, moderately elongate; gill-membranes separate or notched, free or at least forming a free fold across isthmus. Dorsal fin anterior, with a spine; adipose fin present; anal short or of moderate length; pelvic fins usually 6-rayed (7- or 8-rayed in *Rita*). Anterior and posterior nostrils wide apart, the latter usually with a barbel; maxillary and usually one or two pairs of mandibular barbels. Jaws toothed; palate often toothed. Lateral ethmoid facet for articulation of palatine rarely strictly lateral, usually visible when the skull is seen from below; palatine rod-like; pterygoid present, attached to lower surface of hinder part of palatine (fig. 1, B); mesopterygoid small, anterior to the well-developed metapterygoid; hyomandibular with a broad head, fitting into a groove formed by the pterotic and sphenotic. Post-temporal present; supra-cleithrum rigidly attached to skull, with the lower limb well developed; mesocoracoid present; hypocoracoids meeting and interlocking behind the symphysis of the cleithra. Vertebrae 34 to 55 (10-23 + 20-34); ribs attached to long parapophyses; anterior ramus of parapophysis of fourth vertebra firmly attached to supra-cleithrum; air-bladder large, free, normally formed.

Fresh-water fishes of Asia and Africa.

The principal genera may be arranged thus:—

I. Pterygoid and mesopterygoid laminar, rather loosely connected; parapophysis of fourth vertebra intervening between supra-cleithrum and anterior wall of air-bladder; lower limb of supra-cleithrum normal. (*Chrysiichthyinae*.)

A. Parapophysis of fourth vertebra with a stout anterior ramus attached to the supra-cleithrum and connected at the base with the posterior ramus, which resembles a normal parapophysis.

No nasal barbel; anterior nostril labial, poste-

rior slit-like; sixth vertebra free *Parauchenoglanis*, *Auchenoglanis*, *Notoglanidium*.

A nasal barbel; sixth vertebra rigidly united

with fifth *Rita*, *Pseudobagrus*, *Gephyroglanis* *.

* *Leptoglanis*, without nasal barbel, may be related to *Gephyroglanis*.

B. Parapophysis of fourth vertebra a horizontal lamina, sharply bent downward in front to form a thick vertical plate attached to the stem and lower limb of supra-cleithrum; a nasal barbel.

Clarotes, Chrysiichthys *.

II. Pterygoid and mesopterygoid united by suture or ankylosis to form a transverse crescent; parapophysis of fourth vertebra a transverse lamina with a decurved anterior process attached to the inner edge of a vertical laminar expansion of the stem and lower limb of the supra-cleithrum, which supports the anterior wall of the air-bladder; a nasal barbel. (*Bagrinæ*.)

Bagrus, Macrones, Liocassis, Bagroides, Olyra.

Family 7. *Amiuridæ*.

Closely related to the *Bagridæ*, but without a pterygoid and with the pelvic fins 8- or 9-rayed; palate toothless. The vertebræ number 44 to 50 (16-19+28-31), the anterior vertebræ formed as in *Auchenoglanis* or *Rita*; in *Amiurus* the pectoral arch is as in the *Bagridæ*, but in *Noturus* the post-temporal is absent and the lower limb of the supra-cleithrum is short, only connected with the basioccipital by a ligament.

Fresh-water fishes of North America, with a species of *Amiurus* in China.

In some species of *Amiurus* the anal fin is quite long, as in the *Schilbeidæ*, but the skull is typically *Bagrid*, differing from that of the *Schilbeidæ* in the projecting lateral ethmoids and pterotics.

Family 8. *Amblycepidæ*.

External characters of the *Bagridæ*, to which they bear a general resemblance in their osteology, differing in certain features of specialization. The pterygoid is absent, the metapterygoid is reduced, and the elongate mesopterygoid extends from the palatine to the hyomandibular (fig. 1, C). There is no post-temporal and the proximal end of the upper limb of the supra-cleithrum is wedged in between pterotic and epiotic. The parapophyses of the fourth vertebra form on each side a semicylinder incomplete below, or an inverted cup, partly enclosing the reduced air-bladder, which is divided into two lateral sacs. Vertebræ 36 to 45 (15-16+21-29).

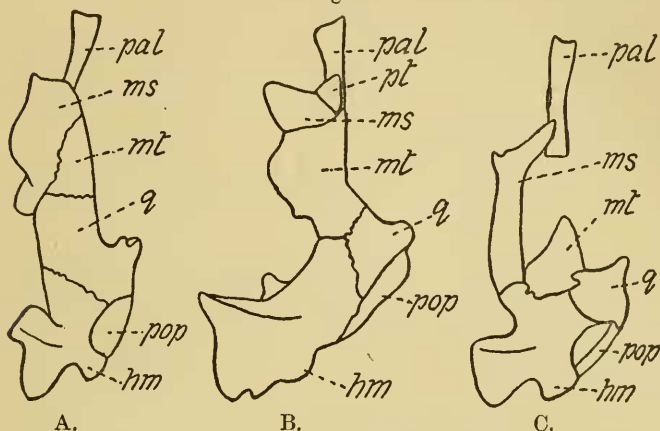
Asiatic fresh-water fishes of small size, belonging to four genera: *Amblyceps*, *Liobagrus*, *Akysis* (*Sosia*) and *Acrochordonichthys*.

I have examined skeletons of *Amblyceps* and *Liobagrus*. 10

* *Phyllonemus*, without nasal barbel, may be related to *Chrysiichthys*.

Akysis and *Acrochordonichthys* resemble them in their air-bladder and anterior vertebræ (*vide* Bridge and Haddon). There is a skeleton of *Akysis major*, Bouleng., in the British Museum collection, but unfortunately this is a species

Fig. 1.



A. *Clarias anguillaris*. B. *Clarotes læviceps*. C. *Liobagrus andersonii*.

Hyopalatine bones of the left side, seen from below. *pal*, palatine; *pt*, pterygoid; *ms*, mesopterygoid; *mt*, metapterygoid; *q*, quadrate; *hm*, hyomandibular; *pop*, præoperculum.

of *Glyptosternum*, whilst Koschkaroff's description and figures of the skeleton of *Akysis* are evidently based on a species of *Macrones* or some related genus.

Family 9. Sisoridæ.

Differ from the Bagridæ in certain features of specialization, such as the absence of pterygoid and post-temporal, the contraction of the head of the hyomandibular, which articulates with the sphenotic only, and the division of the air-bladder into two lateral sacs. Lower surface of head and abdomen flat and paired fins horizontal. Nostrils close together, with a more or less developed barbel between them. Gill-membranes free (*Nangra*, *Bagarius*) or attached to isthmus. Vertebræ 34 to 40 (15-19 + 19-23); parapophysis of the fourth vertebra a lamina which is decurved anteriorly, forming a semicylinder; parapophysis of the fifth vertebra very strong, extending outwards to the skin, rarely uniting with that of the fourth to form a complete cylinder.

Asiatic fresh-water fishes.

Synopsis of the Genera.

I. Præcaudal vertebræ normal, with the ribs attached to simple parapophyses and the neural arches without lateral processes; end of transverse process of fifth vertebra appearing as a rugose plate behind the lateral cutaneous area.

A. Head somewhat compressed and elevated; tail and caudal vertebræ normal.

1. Mesopterygoid smaller than metapterygoid; pelvics behind the dorsal.

Gill-membranes free from isthmus *Nangra*.

Gill-membranes attached to isthmus *Guguta*.

2. Mesopterygoid large, extending to hyomandibular above the reduced metapterygoid; pelvics below the dorsal.

Erethistes.

B. Head depressed; tail long and slender; caudal vertebræ with laminar neural and hæmal spines and lateral laminar processes which may form external series of bony plates.

Pelvics behind the dorsal *Breitensteinia*.

Pelvics below the dorsal *Sisor*.

II. Anterior præcaudal vertebræ with a series of processes on each side directed upwards and outwards from the bases of the neural arches; head depressed.

A. Lips normal; mesopterygoid large, extending forward below the palatine and backwards to the hyomandibular; complex centrum rigidly united, but not ankylosed to cranium; parapophysis of fourth vertebra a half-cylinder, of fifth a stout horizontal process ending just beneath the skin.

1. Ribs inserted on normal transverse processes; pelvics behind the dorsal; gill-membranes free or narrowly attached to isthmus.

Thorax without longitudinal plaits *Bagarius*.

Thorax with longitudinal plaits; palate toothed *Eucliptosternum*.

Thorax with longitudinal plaits; palate toothless . . *Glyptosternum*.

2. Anterior ribs sessile, the rest on transverse processes which are forked at the base; pelvics below the dorsal; gill-membranes broadly attached to isthmus *Pseudecheneis*.

B. Lips expanded and reflected; mesopterygoid not reaching hyomandibular; complex centrum ankylosed with cranium; parapophyses of fourth and fifth vertebræ united to form a complete cylinder on each side; ribs on transverse processes which are forked at the base; gill-membranes broadly attached to isthmus.

Teeth all pointed; gill-openings extending on to lower surface *Parexostoma*.

Teeth all pointed; gill-openings not extending on to lower surface *Euchiloglanis*.

An outer series of blunt compressed teeth *Exostoma*.

Family 10. Amphiliidæ.

Closely related to the Bagridæ, but without pterygoid or post-temporal. Air-bladder reduced and divided into two lateral portions enclosed in incomplete bony cylinders formed by the laminar parapophyses of the fourth vertebra, which are decurved anteriorly, the rather feeble parapophyses of the fifth vertebra, which do not nearly reach the skin, and by two pairs of processes of the complex centrum supporting the air-bladder below. Vertebrae 35 to 41 (16-20 + 18-21). Anterior præcaudals with paired processes directed upwards and outwards from the bases of the neural arches; parapophyses widely forked at the base.

African fishes with depressed head, no nasal barbels, sub-terminal or inferior mouth, toothless palate, and paired fins horizontal and more or less expanded. In the structure of the vertebral column they resemble the Indian *Exostoma* and *Pseudecheneis*, and there are other interesting resemblances between members of this family and of the Sisoridæ, due to convergence.

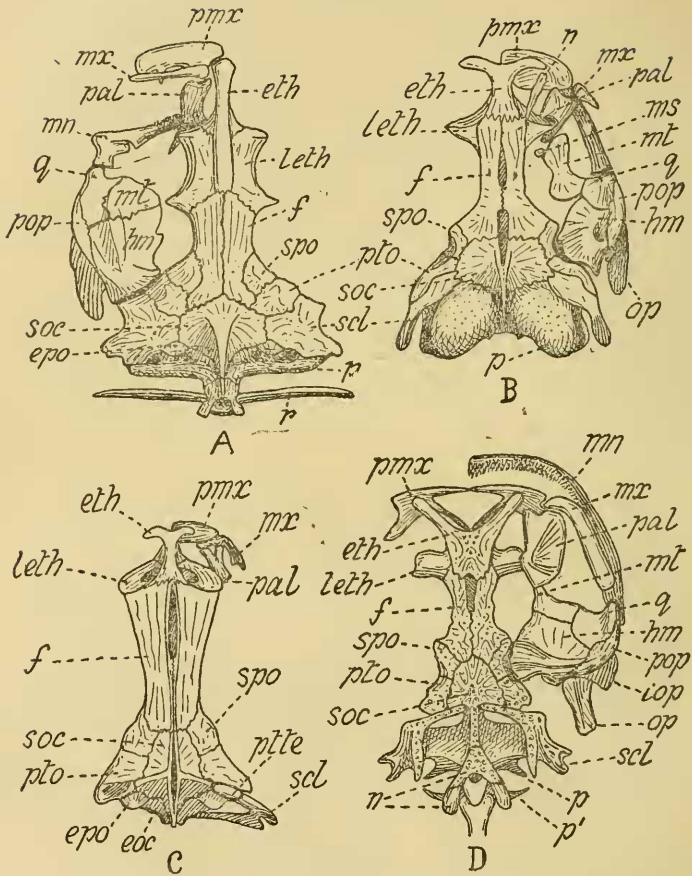
Synopsis of the Genera.

- I. Gill-membranes free from isthmus. All ribs on transverse processes; caudal vertebrae normal. (*Amphiliinæ*)
Amphilius, *Paramphilius*.
- II. Gill-membranes attached to isthmus. Anterior ribs sessile; vertebrae behind dorsal fin with paired laminar processes directed upwards and outwards, those behind the pelvic fins with similar processes directed obliquely downwards, these processes reaching the skin and often expanded distally to form series of bony plates.
- No bony plates *Doumea*.
- Series of bony plates from dorsal and pelvic fins to caudal *Phractura*, *Paraphractura*, *Andersonia*.
- Lower series of bony plates continued forward in advance of pelvic fins *Trachyglanis*, *Belonoglanis*.

Family 11. Chacidæ. (Fig. 2, D.)

The Indian genus *Chaca* appears to be related to the Bagridæ, from which it differs externally in the very large strongly depressed head, the very wide mouth, the broad union of the gill-membranes with the isthmus, and the extension forward of the caudal fin above and below, simulating a second dorsal and anal. The large broad palatine articulates with the strongly projecting lateral ethmoid and posteriorly with the metapterygoid; there is no pterygoid, and

Fig. 2.



A. *Arges heterodon*. B. *Nematogenys inermis*. C. *Diplomystes papillosus*. D. *Chaca lophioides*. Head-skeleton seen from above.

pmx, præmaxillary; *mx*, maxillary; *mn*, lower jaw; *n*, nasal; *pal*, palatine; *ms*, mesopterygoid; *mt*, metapterygoid; *q*, quadrate; *hm*, hyomandibular; *pop*, præoperculum; *op*, operculum; *iop*, interoperculum; *eth*, mesethmoid; *leth*, lateral ethmoid; *f*, frontal; *spo*, sphenotic; *pto*, pterotic; *epo*, epiotic; *soc*, supraoccipital; *eoc*, exoccipital; *pt*, post-temporal; *scl*, supra-cleithrum; *p*, parapophysis of fourth vertebra; *p'*, parapophysis of fifth vertebra; *r*, rib of sixth vertebra; *n*, nuchal plates.

the small mesopterygoid is attached to the lower surface of the palatine. There is no post-temporal, and the supra-cleithrum is like that of the Bunocephalidæ, with the lower limb slender, the upper attached to the supraoccipital and almost reaching the neural crest of the complex vertebra, and the outer division of the stem superior, directed backwards above and united to the parapophysis of the fourth vertebra; a mesocoracoid is present and the hypocoracoids interlock below. Vertebrae 35 (10+25); free præcaudals with ribs attached inferiorly to short parapophyses; fifth parapophysis moderate, at the base laminar and united with the fourth; anterior ramus of fourth parapophysis strong, broad, united distally with the supra-cleithrum, posterior ramus relatively small, similar to the fifth parapophysis. Air-bladder large, free, partly constricted into two lateral divisions.

Family 12. Schilbeidæ.

Closely related to the Bagridæ, but with the anal fin elongate and with the pterygoid absent; pelvic fins 6-rayed.

Indian and African fresh-water fishes; the more generalized members of the family are very near the Bagridæ, but the group is a varied one. The skull is extremely similar in all, differing from that of the Bagridæ and Amiuridæ in its straight parallel edges, the lateral ethmoids scarcely projecting outwards in front of the orbit nor the pterotics behind the articulation of the hyomandibular. The vertebrae number 47 to 58 (10-20+29-47).

The genera may be arranged as follows:—

I. Dorsal fin with a pungent spine; teeth well developed; post-temporal present; hypocoracoids interlocking below; lower limb of supra-cleithrum free. (*Schilbeinæ*.)

A. Air-bladder as in the Bagridæ; anterior vertebrae as in *Rita*; anterior ramus of parapophysis of fourth vertebra stout, connected with posterior at the base; vertebrae 11-17+30-41.

African	<i>Schilbe, Eutropius.</i>
Indian	<i>Pseudeutropius, Lais, Helicophagus, Sihundia.</i>

B. Cavity of air-bladder divided longitudinally into two; parapophysis of fourth vertebra a lamina with the anterior and posterior edges decurved to form a semi-cylinder; vertebrae 19-20+29-33.

Indian	<i>Schilbichthys, Eutropichthys.</i>
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II. Dorsal fin small and spineless, or absent; teeth minute or absent; no post-temporal; other osteological characters of *Schilbe*; vertebræ 10-11+41-44. (*Siluranodontinae*.)

African *Siluranodon*, *Parailia*, *Physalia*.

III. Dorsal fin absent; teeth well developed; post-temporal present; hypocoracoids not meeting; air-bladder tubular, transverse, crescentic, curved forward on each side, the horns lying in a pair of recesses open behind, formed by the laminar parapophyses of the fourth and fifth vertebræ, by a ventral lamina which curves upwards anteriorly, and by the lower limb of the supra-cleithrum; vertebræ 11+41-47. (*Ailiinae*.)

Indian *Ailia*, *Ailichthys*.

Family 13. Clariidæ. ♂

Naked, elongate; gill-membranes separate, free from isthmus. Dorsal fin spineless, commencing not far behind head; anal long, many-rayed, nearly or quite reaching caudal; pelvics, when well-developed, 6-rayed; pectoral with a spine. Head depressed; mouth transverse, terminal; bands of villiform or granular teeth in jaws and on vomer; 4 pairs of barbels, nasal, maxillary, and two mandibular. Cranial roof-bones more or less expanded and laminar, the pterotics appearing as a pair of plates at the sides of the supraoccipital; epiotics concealed beneath supraoccipital; side of head with two plates, the anterior, "postorbital," attached to the frontal above and behind the orbit, the posterior, "temporal," attached to the pterotic and supra-cleithrum. Palatine long, rod-like; pterygoid absent; mesopterygoid large, connecting the rather small metapterygoid with vomer (fig. 1, A). Post-temporal absent; supra-cleithrum a plate rigidly attached to pterotic, without lower limb, with a posterior process firmly united to air-bladder capsule; mesocoracoid present; hypocoracoids interlocking below. Vertebræ 60 to 107; free præcaudals with ribs on well-developed parapophyses; complex vertebra rigidly united with fifth, first and skull, by suture and by investing bone; parapophyses of fourth and fifth vertebræ forming on each side a transverse cylinder or semi-cylinder with terminal aperture beneath the skin; air-bladder represented by two sacs enclosed in the cylinders, connected by a transverse tube from which a duct runs to the œsophagus.

Fresh-water fishes of Africa and Asia.

The Clariidæ are a specialized family, but show relationship to the Schilbeidæ. A good illustrated description of the head-skeleton of *Clarias* has been given by Schelaputin (Bull. Soc. Nat. Moscou, 1905, p. 85).

The genera may be arranged thus :—

I. Gill-cavity with an accessory air-sac, which extends backwards into the tail; dorsal fin short; no adipose fin.

Saccobranchus.

II. Gill-cavity with a diverticulum containing a dendritic accessory branchial organ attached to the second and fourth branchial arches; dorsal fin more or less elongate.

A. An adipose fin *Heterobranchus*, *Dinotopterus*.

B. No adipose fin; dorsal nearly or quite reaching the caudal.

Plates at side of head connected *Clarias*.

Plates at side of head reduced, separated by an interspace *Allabenchelys*, *Clarrialabes*, *Gymnallabes*, *Channalabes*.

Saccobranchus often placed in a separate group, is precisely similar to *Clarias* in osteological characters. The plates protecting the sides of the head are present in all the members of the family, and I have satisfied myself that Boulenger's statement to the contrary for the degraded genera allied to *Clarias* is erroneous. These plates are present in most Siluroids, but not so strongly developed; the anterior belongs to the circumorbital series, the posterior transmits the lateral line to the præoperculum.

Family 14. Pangasiidæ.

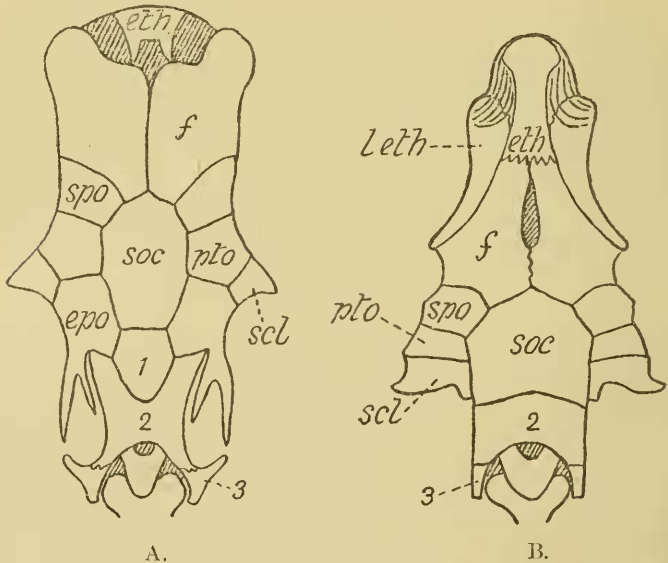
The Indian genus *Pangasius* differs from the Bagridæ externally in the long anal fin, with 28 to 40 rays; maxillary and one pair of mandibular barbels are present, but no nasal barbels. The skeleton is very similar to that of generalized Bagridæ, differing only in the development of an elastic spring mechanism, the anterior rami of the parapophyses of the fourth vertebra being expanded distally to form a pair of oval plates inserted in the anterior wall of the air-bladder, but free from the supra-cleithrum. The air-bladder consists of an anterior division, corresponding to a normal bladder, and of a posterior tubular cæcum. Vertebrae 15 + 29.

Family 15. Synodontidæ.

External characters of the Bagridæ, except that the gill-membranes are confluent with the skin of the isthmus; the nostrils may be close together or wide apart and there is no nasal barbel; the pelvic fins are 7-rayed. There is a broad nuchal shield with parallel edges; the epiotics are small, hidden beneath the supraoccipital; pterygoid and mesopterygoid are absent; there is no post-temporal; the upper

limb of the supra-cleithrum is a plate united with the supraoccipital and the pterotic, the lower limb is expanded vertically. The vertebræ number 33 to 44 (11-17 + 19-27); the fifth and six are rigidly united with the complex; the posterior ramus of the parapophysis of the fourth vertebra is similar to the well-developed parapophysis of the fifth, its anterior ramus is a transverse lamina, with an inferior process expanded to form a thick vertical plate, free from the supra-cleithrum, inserted in the anterior wall of the air-bladder.

Fig. 3.



Diagrams showing the cranial roof-bones of A. *Pseudauchenipterus nodosus* and B. *Euchilichthys royauvi*.

eth, mesethmoid; *leth*, lateral ethmoid; *f*, frontal; *soc*, supraoccipital; *spo*, sphenotic; *pto*, pterotic; *epo*, epiotic; *scl*, supra-cleithrum; 1, 2, 3, nuchal plates.

These African fresh-water fishes resemble the Bagridæ except in the characters of specialization enumerated above.

The genera may be arranged thus:—

- I. Mandibulary barbels branched; maxillaries at the sides of the præmaxillaries; parapophyses of sixth vertebra normal.

Synodontis, *Microsynodontis*, *Mochocus*.

- II. Barbels simple; maxillaries behind the præmaxillaries; parapophyses of sixth vertebra very strong; head depressed; mouth with a papillose circular lip.

Chiloglanis, Euchilichthys, Atopochilus.

The Synodontidæ resemble the South American Doradidæ to a certain extent in their restricted gill-openings, nuchal shield, and elastic spring apparatus. But in the Doradidæ the epiotics are prominent cranial roof-bones which join the nuchal plates (fig. 3, A), a mesopterygoid is present but a mesocoracoid absent, the fourth parapophysis is not divided into anterior and posterior rami and its distal plate is attached to the lateral instead of the anterior wall of the air-bladder, and the fifth parapophysis is vestigial or absent.

Family 16. Malopteruridæ.

The African *Malopterurus electricus* differs from the Bagridæ in the absence of the dorsal fin, the restricted gill-openings, and the development of a subcutaneous electric organ extending over the whole body. Osteological characters indicate relationship to the Bagridæ, but there are several features of specialization. Pterygoid and mesopterygoid are absent, the metapterygoid is firmly connected with a horizontal ledge formed by the lateral ethmoid and orbitosphenoid, and the quadrate extends forward external to the metapterygoid to meet the extremity of the recurved præmaxillary. The skull is narrowed and compressed between the orbits and strongly expanded and depressed behind them, and the sphenotic sends out a strong lateral process to above the eye. The pectoral arch is rather loosely attached, the upper limb of the supraclithrum articulating in a socket between the post-temporal and the epiotic, the lower limb connected to the basioccipital by ligament. The vertebræ number 41 to 44 (20-22 + 21-22); the anterior ramus of the parapophysis of the fourth vertebra is free from the supra cleithrum, thin proximally and expanded distally into a transverse vertical plate, inserted in the anterior wall of the air-bladder. The air-bladder has a large posterior sac, connected by a tube with the smaller anterior division, which represents a normal bladder.

Family 17. Pimelodidæ.

Gill-membranes separate, free from isthmus. Dorsal fin typically anterior and with a spine (above or behind the pelvis and without a spine in *Heptapterus* and *Nannoglanis*); adipose fin present; anal short or of moderate length;

pelvics 6-rayed. Barbels three pairs, maxillary and two mandibular; anterior and posterior nostrils wide apart. Jaws toothed; palate with or without teeth. Palatine rod-like, articulating with the side of the lateral ethmoid; pterygoid, when present, slender, having the appearance of an ossified ligament connecting palatine and mesopterygoid; latter small, lying between the well-developed metapterygoid and the lateral ethmoid. Post-temporal present; supra-cleithrum firmly attached to skull, with a well-developed lower limb; mesocoracoid present; hypocoracoids meeting and interlocking behind the symphysis of the cleithra. Vertebrae 42 to 60 (15-20 + 25-43); ribs on parapophyses; parapophysis of fourth vertebra a horizontal lamina with a more or less distinct stout anterior ramus which is rigidly united with the stem of the supra-cleithrum; air-bladder typically large and free.

Neotropical, fresh water fishes.

This family is closely related to the Indian and African family Bagridæ; it includes a number of diverse types, but is undoubtedly a natural group.

The absence of a nasal barbel usually distinguishes the Pimelodidæ from the Bagridæ, and the few Bagridæ which have no nasal barbel differ from the Pimelodidæ in their united gill-membranes. The skeleton of the two families is extremely similar, but the lateral ethmoid facet for articulation of the palatine is hardly ever strictly lateral in the Bagridæ, and the pterygoid, when present in the Pimelodidæ, is unlike that of either the Chrysichthyinæ or the Bagrinæ. Since the two groups are large, varied, and geographically distinct, and seem to form the starting-point for the evolution of most of the Siluroids of South America and of Asia and Africa respectively, it seems best to recognize them as distinct families.

The following arrangement includes many of the principal genera, but some I have not seen and am unable to place:—

- I. Pterygoid present, slender, attached anteriorly to lower surface of palatine and posteriorly to outer end of the transverse, crescentic mesopterygoid; parapophyses of fourth, fifth, and sixth vertebrae laminar, united by suture; air-bladder normal.

Callophysus, Pimelodus, Piramutana, Sciades.

- II. Pterygoid absent; mesopterygoid laminar, attached in front to lower face of lateral ethmoid and behind to anterior edge of metapterygoid; air-bladder normal.

- A. Anterior and posterior rami of parapophysis of fourth vertebra connected at the base only; sixth vertebra free, with normal transverse process *Pimelodella, Rhamdia, Heptapterus, Nannoglanis.*

- B. Anterior ramus of parapophysis of fourth vertebra only distinct distally; sixth vertebra with a laminar transverse process united by suture with that of the fifth.

Hemisorubim, Pseudoplatystoma.

- III. Pterygoid absent; mesopterygoid laminar, attached to lateral ethmoid, but connected with metapterygoid only by ligament; parapophysis of fourth vertebra a lamina decurved anteriorly, not divided into rami, united with the fifth basally; sixth vertebra free; air-bladder large, free, partly constricted into two lateral sacs; head broad, depressed. . . . *Pseudopimelodus.*

- IV. Pterygoid absent; mesopterygoid a small lamina attached to lower surface of lateral ethmoid and to metapterygoid, which is produced forward external to it; parapophysis of fourth vertebra united with fifth, curved to form a semi-cylinder open behind, containing the lateral portion of the reduced and divided air-bladder; sixth vertebra not free, but with normal parapophyses.

Luciopimelodus.

- V. Pterygoid absent; mesopterygoid small, articulated with posterior face of lateral ethmoid and with metapterygoid, which extends forward below the lateral ethmoid; parapophyses of fourth, fifth, and sixth vertebrae laminar, united by suture; air-bladder normal.

Sorubim, Platystomatichthys.

Family 18. Helogenidæ.

The South American genus *Helogenes* differs externally from the Pimelodidæ in the fins, as the dorsal is spineless, median in position, followed by a small adipose fin and placed above the long anal, which has 42 rays. The air-bladder is free, of moderate size, placed transversely, and incompletely divided into two compartments. The upper limb of the supra-cleithrum seems to be only loosely attached to the skull and the hypocoracoids do not form a symphysis.

The relations of this genus appear to be about equally close with the Pimelodidæ and with *Cetopsis*; one of the types has been partly dissected for examination of the air-bladder, but until a skeleton is available the exact position of *Helogenes* must remain uncertain.

Family 19. Hypophthalmidæ.

The neotropical genus *Hypophthalmus* differs from the Pimelodidæ externally in the toothless mouth, ventro-lateral position of the eyes, very wide gill-openings, very long many-rayed anal fin, and insertion of the pelvic fins in advance of the dorsal. The lower pharyngeals are united to form a Y-shaped bone with long anterior stem lying in the narrow isthmus and with small toothed posterior forks. The air-bladder is reduced to two small sacs, each enclosed in a bony capsule with a lateral opening beneath the skin,

formed by the parapophyses of the fourth and fifth vertebræ and by the upper limb of the supra-cleithrum. The vertebræ number 66 (14 + 52), the first five ankylosed; the ribs are inserted on parapophyses.

Family 20. *Trichomycteridæ*. (Fig. 2, B.)

Body naked, moderately elongate. Gill-openings wide or restricted. Dorsal fin short, without spine; no adipose fin; anal short or moderately long; pelvics 5- or 6-rayed. Nostrils remote, the anterior sometimes with a barbel; teeth in jaws villiform or incisor-like; palate sometimes toothed. Palatine broad; pterygoid absent; mesopterygoid, when present, very small, attached to inner edge of metapterygoid, which joins palatine. Skull depressed, contracted between and expanded behind the orbits. Post-temporal absent; upper limb of supra-cleithrum suturally united to supraoccipital and pterotic; mesocoracoid present; hypocoracoids narrowed forward below, pointed anteriorly, not interlocking. Vertebræ 42 to 46 (19-21 + 23-25); ribs on parapophyses; fifth vertebra ankylosed with the complex, which is short, rigidly attached or ankylosed to the skull, and bears a pair of transverse subcylindrical capsules with lateral openings; air-bladder divided into two lateral sacs enclosed in the bony capsules.

Fresh-water fishes of South America.

The principal genera may be arranged thus:—

I. Air-bladder capsule formed by the parapophysis of the fourth vertebra, in front free from the skull and normally attached to the supra-cleithrum, behind free from the normal parapophysis of the fifth vertebra; dorsal fin anterior; opercles unarmed; one pair of maxillary barbels. (*Cetopsinæ*.)

Cetopsis.

II. Air-bladder capsule united to the skull, its anterior wall including the lower limb of supra-cleithrum and a part of the exoccipital and epiotic bones; parapophysis of fifth vertebra not developed as a separate process; dorsal fin median or posterior. (*Trichomycterinæ*.)

A. Opercles unarmed; one pair of maxillary barbels.

Nematogenys.

B. Operculum and interoperculum armed with spines.

One pair of maxillary barbels *Stegophilus*, *Vandellia*.

Two pairs of maxillary barbels *Trichomycterus*, *Eremophilus*,
Tridens, *Pariodon*, *Miuroglanis*.

Family 21. *Bunocephalidæ*.

Gill-openings reduced to a small foramen in front of the pectoral fin. Dorsal fin anterior; no adipose fin; caudal

small, few-rayed; anal short or long; pelvics 6-rayed, below the dorsal. Head depressed; nostrils remote, without barbel; villiform teeth in the jaws; palate toothless. Palatine rod like; mesopterygoid, when present, small, attached to lateral ethmoid; operculum reduced, scarcely larger than a branchiostegal ray, but attached anteriorly to the interoperculum. Skull depressed, the pterotics with strong lateral laminar projections. No post-temporal; supra-cleithrum forked, the lower limb slender, running to basioccipital, the upper extending nearly to the middle of the supraoccipital; no mesocoracoid; hypocoracoids interlocking below. Vertebrae 34 to 75 (10+24-65), strongly compressed, with laminar neural and hæmal spines and with a series of horizontal lateral processes arising on each side from the middle of the centra; free præcaudal vertebrae without parapophyses, with sessile ribs; fifth vertebra rather long, rigidly united with complex, their neural spines forming a low ridge of bone with thickened dorsal edge which joins the supraoccipital anteriorly; parapophysis of fifth vertebra a very strong process; parapophysis of fourth a lamina, united posteriorly to the base of the fifth, anteriorly decurved and united to the stem of the supra-cleithrum. Air-bladder large, free, partly constricted into two lateral portions.

South-American fresh-water fishes.

Bunocephalus, *Bunocephalichthys* and *Dysichthys* have a short tail, anal 5- to 9-rayed, and about 24 caudal vertebrae. *Platystacus* (*Aspredo*) has a long tail, anal 50- to 60-rayed, and 60 or more caudal vertebrae.

Family 22. Callichthyidæ.

Body armoured with two series of overlapping bony laminae on each side. Gill-membranes broadly united to isthmus. Dorsal fin anterior; adipose fin with a spine; anal short; pelvics below the dorsal. Mouth small, terminal; præmaxillaries small, movably attached to mesethmoid; rami of lower jaw slender; jaws with or without feeble teeth; palate toothless; one or two pairs of maxillary barbels. Palatine articulating with anterior end of lateral ethmoid; pterygoid and mesopterygoid absent; anterior end of metapterygoid connected with lateral ethmoid and palatine by a ligament. Bones of cranial roof more or less expanded and plate-like; suborbitals well-ossified, with an inner shelf; operculum large. Post-temporal absent; supra-cleithrum a large plate ankylosed with the pterotic, connected with sphenotic and supra-occipital above, prootic

and exoccipital below, and parapophysis of fourth vertebra behind; cleithrum transversely expanded; mesocoracoid present; hypocoracoids interlocking below. Vertebrae 27-32 (13-18+12-14); caudal vertebrae normal, with slender neural and hæmal spines; præcaudal vertebrae, from seventh to last, with slender ribs, all (*Corydoras*) or the anterior sessile; sixth vertebra free, with a strong rib supporting the first lateral plate of the lower series, borne on a stout parapophysis which articulates with that of the fifth vertebra; complex vertebra ankylosed with fifth and with skull, its parapophyses forming with the supra-cleithra and exoccipitals a pair of subcylindrical capsules opening laterally beneath clefts in the supra-cleithral plates; air-bladder divided into two sacs enclosed in the capsules.

South-American fresh-water fishes.

Genera: *Scleromystax*, *Callichthys*, *Hoplosternum*, *Decapogon*, *Dianema*, *Corydoras*.

Family 23. Loricariidæ. (Fig. 2, A.)

Body naked, or armoured with bony scutes, which anteriorly form five longitudinal series on each side. Gill-membranes broadly united to isthmus. Dorsal fin anterior; anal short; pelvics below or in advance of the dorsal. Mouth inferior, with expanded lips forming a sucker; præmaxillaries movably articulated with mesethmoid; jaws toothed; palate toothless; a pair of maxillary barbels. Palatine articulating with anterior end of lateral ethmoid; pterygoid and mesopterygoid absent. Post-temporal absent; supra-cleithrum a large plate united with pterotic and supra-occipital above, prootic and exoccipital below, and parapophysis of fourth vertebra behind; cleithrum transversely expanded; mesocoracoid present. Vertebrae 27 to 38 (10-18+14-26); caudal vertebrae compressed, with neural and hæmal spines more or less expanded; free præcaudals without parapophyses, with sessile ribs; a pair of very strong sessile ribs borne by the sixth vertebra, which is rigidly united to the fifth and articulates with the seventh by a hinge which restricts lateral movement; complex vertebra united to fifth and to skull by suture or ankylosis; parapophyses of fifth vertebra absent, of fourth forming with supra-cleithra and exoccipitals a pair of capsules opening laterally beneath the notched or perforated supra-cleithral plates; air-bladder reduced to two sacs enclosed in the capsules.

South-American fresh-water fishes.

In 1904 (Trans. Zool. Soc. xvii. pt. 3) I arranged the genera in five subfamilies; these may be grouped as follows:—

I. Pharyngeals toothless; hæmal spines not bifid; supra-cleithral plate extending downwards, its inner surface attached to the outer edge of the cleithrum, but not forming a definite articulation with it; body usually armoured; inner edge of metapterygoid attached to lateral ethmoid; hypocoracoids interlocking.

Plecostominae, Hypoptopomatinae.

II. Lower and fourth upper pharyngeals toothed; anterior hæmal spines bifid for reception of anal basalia; supra-cleithral plate scarcely decurved, its lower surface with a transverse ridge fitting a groove on the upper edge of the supra-cleithral expansion external to the head of the bone.

Body armoured; metapterygoid attached to lateral ethmoid; lower portions of cleithra transverse; hypocoracoids interlocking below

Loricariinae, Neoplecostominae.

Body naked; metapterygoid small, not reaching skull; cleithra running somewhat forward to their symphysis; hypocoracoids tapering forward below, not interlocking

Argiinae.

It seems to me that if the *Argiidae* are to be separated off as a distinct family, the *Plecostomidae* also should be recognized, as they differ quite as much from the *Loricariidae*.

LXVI.—*New Species of Heterocera from Costa Rica.*—XI.

By W. SCHAUS, F.Z.S.

Geometridæ.

Aplogompha argentilinea, sp. n.

♂. Palpi and frons lilacine buff; vertex, collar, and thorax dull lilacine brown; abdomen dark brown above, silvery grey below. Fore wings: the basal half to middle of costa and postmedial line on inner margin black-brown, crossed by some buff striæ, and containing a few metallic scales in cell outwardly, followed by a large triangular whitish space shaded with fuscous scales and with its apex at vein 2, its costal area shaded with buff; a postmedial dark reddish-brown line, followed by fine buff and dark brown lines, and a heavy silvery line outwardly shaded with black and not reaching costa; a dull buff-grey space beyond the silver line limited by a straight subterminal white line, beyond which